Superfund Program
Proposed Plan

U.S. Environmental Protection Agency
Region 2

Raritan Bay Slag Superfund Site

Townships of Old Bridge/Sayreville, New Jersey

September 2012

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the preferred alternative for addressing the site-wide soils and sediments at the Raritan Bay Slag Superfund Site and provides the rationale for those preferences.

The U.S. Environmental Protection Agency's (EPA's) Preferred Alternative includes excavation/dredging, off-site disposal, institutional controls and long-term monitoring. Slag, battery casing/associated wastes, contaminated soils and sediments above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate in excavated Margaret's Creek upland areas. Soils and sediments have been found to be contaminated with heavy metals from erosion of particulates and leaching from slag and battery casings/associated wastes. The Preferred Alternative incorporates cleanup actions to complete the response action at the site.

EPA is proposing active measures to address the site-wide contaminated soils and sediments as the preferred alternative. EPA is recommending Remedial Alternative 2, identified as Excavation/Dredging, Off-site Disposal, and Long-Term Monitoring.

This Proposed Plan summarizes the data and rationale considered in making this recommendation. This document is issued by EPA, the lead agency for site activities. EPA, in consultation with the New Jersey Department of Environmental Protection (NJDEP), the support agency for site activities, will select the remedy for the Site after reviewing and considering all information submitted during a 30-day public comment period. EPA, in consultation with NJDEP, may modify the preferred alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the information presented in this Proposed Plan.

MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD:
September 28, 2012 through October 29, 2012, U.S. EPA will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING:
October 17, 2012, at 7:00 P.M.
U.S. EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at the:

George Bush Senior Center
1 Old Bridge Plaza
Old Bridge, NJ 08857

For more information, see the Administrative Record at the following locations:

U.S. EPA Records Center, Region 2
290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4308
Hours: Monday-Friday, 9 AM to 5 PM

Old Bridge Central Library
1 Old Bridge Plaza
Municipal Center
Old Bridge, NJ 08857
Hours: Monday - Friday 9:30 AM - 9 PM
Saturday 9:30 AM – 5 PM, Sunday 12:30 - 5 PM

Sayreville Library
1050 Washington Rd.
Parlin, NJ 08859
(732) 727-0212
Hours: Monday -Tuesday 9:30 AM - 7:45 PM
Friday and Saturday 9:30 - 4:45 PM, Sunday 1 - 4:45 PM

N.J. Department of Environmental Protection
401 East State Street, Trenton, New Jersey

Bridgewater Township Library
1 Vogt Drive, Bridgewater, New Jersey

EPA is issuing this Proposed Plan as part of its community relations program under Section 117(a) of Comprehensive Environmental Response, Compensation and Liability act (CERCLA, or Superfund). This Proposed Plan summarizes information that can be found in greater detail in several reports included in the Administrative Record.

SITE DESCRIPTION

The site is located on the shore of Raritan Bay, in the eastern part of Old Bridge Township within the Laurence Harbor section in Middlesex County, New Jersey. A small portion of the western end of the site, the western jetty at the Cheesequake Creek Inlet, is located in the Borough of Sayreville. The site is bordered to the north by Raritan Bay and to the east, west, and south by residential properties (Figure 1).

The site is approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. The portion of the site in Laurence Harbor is part of Old Bridge Waterfront Park. The park includes walking paths, a playground area, several public beaches, and three jetties, not including the two jetties (western jetty and eastern jetty) at the Cheesequake Creek Inlet. The park waterfront is protected by a seawall, which is partially constructed with pieces of waste slag from a secondary lead smelter. The western jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty are located in Sayreville. Slag has been placed on top of the western jetty and is observed along the adjoining waterfront. Slag was also observed in the Margaret's Creek area, an undeveloped 47-acre wetland located southeast of the seawall in Laurence Harbor.

The site has been divided into 11 Site Areas for ease of discussion based on areas identified in historical investigations, site physical characteristics, and the locations of known or potential sources. The 11 Site Areas are shown on Figure 2. Discussions are organized into three sectors based on the type of environment and proximity to source areas; sectors include the Seawall Sector (Areas 1, 2, 3, 4, 5, and 6), the Jetty Sector (Areas 7, 8, and 11), and the Margaret's Creek Sector (Area 9 which consists of a wetlands portion and an upland portion). Area 10, a non-impacted area located to the east of the site, was used to collect background samples.

SITE HISTORY

The slag was deposited at the beachfront in the late 1960s and early 1970s, mostly in the form of blast furnace pot bottoms or kettle bottoms from a secondary lead smelter, in an area that had sustained significant beach erosion and damage due to a series of storms in the 1960s. Demolition debris in the form of concrete and a variety of bricks, including fire bricks, was also placed along the beachfront. A portion of the seawall also contains large riprap believed to have been placed over the slag when the grassed and paved portion of the park was developed.

The western jetty at Cheesequake Creek Inlet is part of a federally authorized navigation project by the United States Army Corps of Engineers (USACE) and has been in existence since the USACE constructed it in the late nineteenth century. The slag is believed to have been placed on the western jetty during the same general time period as the construction of the seawall. The entire western jetty is covered with slag that is similar in appearance to the slag on the seawall. The slag was used to supplement the jetty and as fill/stabilizing material for the seawall.

Elevated levels of lead, antimony, arsenic, copper, and chromium were identified by NJDEP in soil along the seawall in 2007 and at the edge of the beach near the western end of the seawall. Old Bridge Township placed a temporary "snow" fence in this area, posted "Keep-off" signs in the park along the split rail fence that borders the edge of the seawall, and notified the residents of Laurence Harbor.

EPA collected samples at the site in September 2008 as part of an Integrated Assessment. The purpose of this sampling event was to determine whether further action under CERCLA was needed. The sampling included the collection of soil, sediment, surface water, biological, and slag samples along the seawall in Laurence Harbor, the western jetty at the Cheesequake Creek Inlet, the beaches near these two locations, and the developed portion of the park. EPA and NJDEP analytical results determined that significantly elevated levels of lead and other heavy metals are present in the soils, sediment, and surface water in and around both the seawall in Laurence Harbor and the western jetty at the Cheesequake Creek Inlet.

At EPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the seawall in Laurence Harbor, the beach between the western end of the seawall and the first jetty, and the western jetty at the Cheesequake Creek Inlet, including the waterfront area immediately west of the inlet (ATSDR 2009). As a result of this determination, EPA's Removal Action Branch conducted a removal action to restrict access to these areas (by installing permanent fences and posting signs) and provided public outreach to inform residents and those using these areas of the health hazard that exists.

On April 24, 2008, EPA received a request from NJDEP to evaluate the Laurence Harbor seawall for a removal action under CERCLA. On November 3, 2008, NJDEP forwarded an amended request to include the western jetty along the Cheesequake Creek Inlet as part of the overall site. In March 2009, the 47-acre property associated with Margaret's Creek was also included in the overall site. The site was listed on the National Priorities List in November 2009.

SITE CHARACTERISTICS

The site consists of a waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. It is located on the shore of Raritan Bay.

Topography and Bathymetry
The site topography is characterized by a gradual rise along the beach to shore bluffs. The bluffs extend the length of the site along the Bay except for Area 9, in front of the Margaret's Creek wetlands. The elevation at the top of the shore bluffs is about 30 feet above mean sea level. South of the bluffs, the terrain is primarily flat.

The Raritan Bay bathymetry near the beach is characterized by a very gradual seaward slope. A significant ebb shoal (shallow depositional area) has built up near the mouth of Cheesequake Creek. North of this ebb shoal, the depth increases sharply.

Surface Water Hydrology, Floodplain and Wetlands
Surface water drainage in the vicinity of the site is toward tidal creeks, the bay and their associated wetlands. The major surface water bodies at the site include Raritan Bay, Cheesequake Creek, and Margaret's Creek. These water bodies are subject to tidal fluctuations averaging 5.5 feet. Because the slope of the Raritan Bay floor is very gentle, 400 to 600 feet of the Bay floor are exposed during low spring tide.

The entire site, except for small portions of the upland areas in Margaret's Creek Sector, is within zones of high or moderate flooding. Wetlands at the site are all sub-tidal or intertidal estuarine habitats. The wetlands of Margaret's Creek are a mixture of unconsolidated shore with organic soil and emergent wetlands that are vegetated and partially flooded.

Sediment Characteristics
The beach areas are sandy with little organic carbon. Upland of the beaches, soils are more organic-rich and contain a higher proportion of silt and clays. The sub-tidal and intertidal areas along Raritan Bay are predominantly sandy, with little silt, clay, or organic carbon.

Sediment Dynamics
In Raritan Bay, wave-driven and tidal currents transport sediment. Storms can increase the quantity of sediment currents transport by up to a factor of four (Woods Hole Group [WHG], 2011). Across most of the shoreline, non-cohesive sand on beaches and on the Bay floor is readily mobilized into currents. The seawall and revetment (Area 6) limit sand supply.

Since the Bay shoreline is relatively quiet and protected from ocean swells, significant waves and mixing occur only during storm events. Wave-induced mixing is expected to be prominent on beaches and could result in contamination being present at depth on beaches. Cohesive sediments and lower-energy environments are present in the lee (western side) of the Cheesequake Creek western jetty, limiting sediment erosion and mixing.

Jetties along Raritan Bay affect sediment transport. The lee side of the Cheesequake Creek western jetty is a very low energy environment protected from waves and storms. Depositional areas are present just off the eastern Cheesequake Creek jetty. A depositional shoal is also present offshore of the mouth of Margaret's Creek. A dynamic mixing zone is present just offshore of the Cheesequake Creek western jetty with irregular accumulation and sediment is rearranged frequently.

Geochronology studies, designed to assess the rate of deposition, were conducted in the Margaret's Creek wetlands because it is relatively protected from the wind and waves that would disturb sediment stratigraphy. Geochronology cores were not collected off-shore because it is a dynamic wave influenced area with no undisturbed sediment. Data show that sediment deposition is actively occurring across the open water portions of the wetlands.

GEOLOGY AND HYDROGEOLOGY

Geology
The site is located in the Coastal Plain Physiographic Province of New Jersey, a seaward-sloping wedge of unconsolidated sediments ranging in age from Cretaceous to Holocene. The coastal plain sediments are composed of clay, sand, silt, and gravel, and are overlain by Quaternary age deposits. In the vicinity of the site, the Quaternary deposits are underlain by the Upper Cretaceous age Magothy and Raritan Formations which are, in turn, underlain by the Lower Cretaceous age Potomac Group.

Hydrogeology
The site is located within the Raritan River Basin. This Basin is bounded by the Passaic River Basin to the north, Delaware River Basin to the west and Atlantic Coastal

Basin to the south. The major aquifer system in this region is the New Jersey Coastal Plain Aquifer System.

Hydrodynamics

Since Raritan Bay is relatively calm during normal conditions, the majority of sediment movement occurs during storms. Waves in the Bay originate predominantly from the east and northeast (Atlantic Ocean). Thus, contaminants from the seawall and the Margaret's Creek area tend to migrate westward toward the western jetty. Currents near the Cheesequake Creek Inlet and western jetty are complex due to the strong dominant tidal currents within Cheesequake Creek. Per tidal cycle, more water and sediment exit Cheesequake Creek than enters. In Margaret's Creek, the regular flow of water through the wetlands produces minimal currents, although storm surges could produce stronger currents.

Groundwater and Surface Water Interaction

Groundwater and surface water interaction at the site were evaluated by collecting a series of synoptic water level measurements from all monitoring wells and staff gauges. Continuous water level data from selected monitoring wells was also collected.

At the western end of the seawall, under low tide conditions, groundwater flow is toward the Bay. Under high tide conditions, the overall groundwater flow direction is also toward the Bay, but the flow is more complex due to the influence of tides and the vertical gradient. Flow in the deeper zone tends to stagnate on the inland side of the seawall while shallow groundwater flow is still toward the Bay. The eastern end of the seawall at low and high tide shows a simpler relationship between groundwater elevation and tidal elevation; lateral groundwater flow at low tide is toward the Bay while at high tide, lateral groundwater flow is inland.

Near the foot of the Cheesequake Creek western jetty, the deep and shallow water levels were essentially the same. They both fluctuated about 6 feet in response to tidal changes in the channel on one side and beach on the other side.

In the Margaret's Creek area about 250 feet to 1,200 feet inland from the Bay, no significant tidal influence was noted. However, the difference in water level elevation along this section is about 4 feet. This observation indicates that there is a consistent component of shallow groundwater flow toward the Bay in this area.

ADDITIONAL INVESTIGATIONS

Remedial Investigation (RI) field activities were conducted from September 2010 through June 2011. Activities focused on collecting sufficient data to fill gaps in the existing data as identified in the Final (Revised) Data Gap Evaluation Technical Memorandum (CDM Smith 2010). The major elements of the field investigation are outlined below.

Survey and Study Activities

Topographic and bathymetric surveys were conducted to provide information on the geometry and physical features of the Raritan Bay floor, beaches, and upland areas, including the surrounding residential communities. The data were used to delineate the upland and intertidal zones.

•Hydrodynamics and sediment dynamics studies were conducted to provide data on currents and sediment transport in the nearshore environment of Raritan Bay.

•A slag distribution study and a slag survey were conducted to define the distribution of slag at the site. The slag distribution study included test excavations to identify the buried slag in the vicinity of the seawall. The slag survey was conducted to visually identify and estimate the volume of slag and battery casings at the seawall, beachfront areas, western jetty, and Margaret's Creek area.

•Exchange studies were conducted in the Cheesequake Creek Inlet and Margaret's Creek to estimate the exchange (flux) of contaminants between the creeks and the bay.

•A hydrogeologic assessment was conducted to provide the data to evaluate geologic and hydrogeologic conditions at the site and included:

Monitoring Wells – A total of 15 shallow and 6 deep wells were installed in the overburden to determine the groundwater flow direction, horizontal and vertical hydraulic gradients, tidal effects, and establish baseline groundwater quality (FS Figure 1-21).

Groundwater and Surface Water Interaction - Continuous water level measurements were recorded in 15 monitoring wells for a period of one month. To document long-term changes in groundwater elevations, six rounds of synoptic water level measurements were taken from February to June 2011.

•A Stage IA cultural resources survey was conducted to identify any cultural or archeological resources within the study area. The survey excluded areas of Margaret's Creek where previous Stage 1A and Stage 1B cultural resources surveys were conducted by Old Bridge Municipal Utilities Authority. Several moderate to high archaeological sensitive locations were identified within or border the site. Additional surveys may be performed during the remedial design to confirm if they are archaeological sensitive locations. These locations are not expected to be impacted by activities at the site.

•An ecological characterization survey was conducted to characterize habitats in the study area and to identify threatened and endangered species. The survey covered the uplands, beaches, and nearshore environment of Raritan Bay.

Seawall Sector Samples
The Seawall Sector (Areas 1, 2, 3, 4, 5, and 6) samples were collected from upland, beach, and tidal areas potentially impacted by slag material in and around the seawall. A total of 291 sediment samples, 219 soil samples, and 37 surface water samples were collected from the Seawall Sector.

Jetty Sector Samples
The Jetty Sector (Areas 7, 8, and 11) samples were collected from upland, beach, and tidal areas potentially impacted by slag material in and around the western Cheesequake Creek Inlet Jetty. A total of 165 sediment samples, 52 soil samples, and 25 surface water samples were collected from the Jetty Sector.

Margaret's Creek Sector Samples
The Margaret's Creek Sector (Area 9) samples were collected from upland, beach, and wetland areas potentially impacted by fill material. A total of 184 sediment samples, 276 soil samples, and 21surface water samples were collected from the Margaret's Creek Sector.

Groundwater Samples
One round of groundwater samples was collected from 21 monitoring wells installed during the field investigation. Wells MW-10S and MW-10D were subsequently resampled to confirm previous lead results.

Biota Samples
Biological samples included blue crabs, hard clams, ribbed mussels, killifish, long neck clams, sea lettuce and six species of game fish across the site.

Bioavailability Samples
Forty soil samples were collected from Areas 2, 3, 5, 6, and 9 for in-vitro bioavailability and electron microprobe analysis for lead and arsenic.

Technical Review Workshop Lead Composite Samples
EPA's Lead Technical Review Workgroup (TRW) has specific guidance on lead sampling. Composite soil samples were collected from 203 locations above the spring low tide line and analyzed for lead. Each composite consisted of five subsamples collected within a 50-foot radius of a center point at a depth of 0-2 inches to be representative of soil that is likely to be ingested.

Background Samples
Sediment, surface water, soil, and groundwater samples were collected to develop site-specific background concentrations. Forty-nine background sediment, 25 background soil samples, and 11 background TRW samples were collected from Area 10. Twelve background surface water samples were collected from Raritan Bay. Background groundwater samples were collected from monitoring well MW-11S, located upgradient of the site wells.

NATURE AND EXTENT OF CONTAMINATION

The evaluation of the nature and extent of contamination focused on those constituents identified as site-related contaminants (i.e., lead, arsenic, copper, antimony, chromium, and iron) in site sediment, surface water, soil, and groundwater. Conservative, health-protective preliminary screening criteria were used in the initial step to identify the nature and extent of contamination in site media. It is important to note that concentrations that exceeded these preliminary screening criteria are not necessarily associated with unacceptable risk to human health or the environment, but are used to define the areas that required further evaluation.

Selection of Site - Related Contaminants
To provide a focused assessment of the large quantity of analytical data, several key contaminants were identified and used in previous reports and the RI report. The metals lead, arsenic, copper, antimony, chromium, and iron are known to be associated with the slag source material and were detected frequently in all media and often at elevated levels. Of particular importance is lead, which was identified as contributing significantly to potential risk in the media evaluated at the site.

Other metals, including, cadmium, cobalt, nickel, selenium, silver, thallium, tin, and zinc, were found in varying but lower proportions in slag. These metals did not drive human health or ecological risks and were detected less frequently than the site-related contaminants that were used to evaluate contamination at the site.

Background Samples
Sediment, surface water, soil, and groundwater samples were collected and site-specific background concentrations for metals in sediment (both Bay and wetlands) and soil were developed for use in the Feasibility Study (FS).

Area 10 was selected as the background location for soils, surface water, and sediments. For wetland sediments, Whaler's Creek was identified as the background location. This area is located out of the watershed and is not impacted or influenced by the site. Sediments collected from Whaler's Creek were used for ecological risk purposes only.

Test Excavations
Slag was observed in 7 of the 26 test excavations in Areas 1 and 4. Slag depths ranged from 1 to 5 feet below ground surface (bgs). Most of the slag observations were along or near the seawall. In general, lead, arsenic, copper, antimony, and chromium exceeded their respective screening criteria in test pit samples collected along or near the seawall. Arsenic also exceeded its screening criterion in one sample collected from the beach in Area 2.

Slag Leaching Tests
Slag samples and slag cores were subjected to a variety of leaching tests (Schnabel 2011 provided in Appendix B of the FS), including synthetic precipitation leaching procedure (SPLP), toxicity characteristic leaching procedure (TCLP), semi-dynamic leach and de-ionized water (DIW) using the SPLP procedure. These various leaching tests confirm that lead is leachable from the slag under different conditions. Concentrations of lead in both composite and core slag samples were identified at levels ranging from 38,000 mg/kg to 91,000 mg/kg.

Leachability from the slag was also examined in a neutral salt extraction procedure, used to simulate conditions in which slag is exposed to seawater. Under these conditions, lead was determined to be leachable while arsenic, copper, antimony, and tin did not leach. It was demonstrated that core samples had considerably higher levels of leachable lead than exterior slag samples but levels from both core and exterior samples were above the drinking water Maximum Contaminant Level (MCL). These leaching tests show that if the slag comes into contact with fresh or salt water, it will leach lead. As a result, the slag must be chemically stabilized to minimize the leaching potential. The potential for the slag to contact water must be minimized, or leachate from the slag must be prevented from discharging into the environment.

Battery Casing Leaching Tests
TCLP tests were conducted on the battery casings by analyzing three composite samples from battery casing piles in the upland area of the Margaret's Creek Sector, the Area 2 beach, and the landward end of the western jetty. Lead was the only metal to leach in significant quantities. Samples from the Area 2 beach were below the 5.0 milligram per liter (mg/L) regulatory TCLP limit. Samples from the Margaret's Creek Sector and western jetty composite samples were both above the TCLP limit.

Slag Survey / Battery Casing Survey
Slag and battery casing surveys were conducted at the western jetty, seawall, and Margaret's Creek Sector to determine slag and/or battery casing distribution and volumes. The survey was conducted through visual observation only. The estimated volume of slag for the western jetty is 5,000 cubic yards (CY). The estimated volume of slag for the seawall is 5,300 CY. The estimated volume of battery casings for the beachfront is 70 CY. The estimated volume of slag for Margaret's Creek Sector is 470 CY and of battery casings is 250 CY. The locations of the slag and battery casings (source material) are shown in Figures 3-6.

Summary of Seawall Sector
The primary sources of site-related metals contamination are slag and battery casings. The seawall is up to 80 percent slag. Battery casings were found in the upper two inches of depositional zones in Areas 2 and 5. Buried slag was observed in test excavations on the upland side of the seawall in Area 1 and the eastern end of Area 4.

Generally, site-related soil and sediment contamination in the Seawall Sector is defined by co-located lead and arsenic contamination exceeding the screening criteria in specific depositional areas (Areas 2 and 5) and in areas associated with slag.

Along the eastern 1,000 feet of the seawall, co-located lead and arsenic that exceeded the preliminary screening criteria occur along the mean high tide line. Most of the contamination in this area is in the shallow soils and sediment. In Area 2, in the soils and near-shore sediments, lead and arsenic concentrations both exceeded the preliminary screening criteria. Deeper soils in this area also exceeded both the lead and arsenic human health screening criteria. In Area 5, near the first jetty, co-located lead and arsenic in soil and sediment exceeded the initial screening criteria. Deeper soil and sediment from this area did not.

Other site-related metals were detected at some locations where lead and arsenic contamination were not co-located.

In surface water, lead was commonly detected above the site-specific screening criterion in surface water samples collected from the intertidal zone, between the eastern end of Area 1 and the western end of Area 6; the highest concentrations were in Areas 1 and 2. Arsenic was detected above its site-specific screening criterion less frequently than lead.

Summary of Jetty Sector
The western jetty and adjacent areas contain slag and some battery casings. The western side of the western jetty and the adjacent shoreline are comprised of 80 to 90 percent slag. The prevailing currents in the vicinity of the western jetty promote sediment deposition on the western side of the jetty and transport of sediment into Raritan Bay. The

fine-grained organic rich sediments in this area tend to sorb metals.

The highest concentrations of lead and arsenic in the Jetty Sector sediments, soils, and surface water were located on and to the west of the western jetty. Sediment contamination, initially defined by the co-location of lead and arsenic that exceeded preliminary site-specific screening criteria, included the area from the western jetty westward approximately 200 feet into Area 8, and seaward of the western jetty in Area 7. Co-located soil and sediment lead and arsenic above the preliminary site-specific screening criteria extended 1,000 feet northwest of the western jetty and westward along the shore into Area 11. In Area 11, co-located lead and arsenic contamination was found along the mean high tide line and the intertidal zone. The vertical extent of sediment contamination along the entire length of the jetty has not been fully delineated, but the horizontal extent of deeper contamination is bounded to the west.

Concentrations of lead and arsenic in soils in the Jetty Sector exceeded preliminary site-specific soil screening criteria. The shallow soils most impacted by site-related metals were on and adjacent to the western jetty. In deeper soils, lead and arsenic concentrations exceeding the preliminary site-specific screening criteria are limited to the western jetty and Area 8 beach.

The majority of surface water samples collected from the Jetty Sector did not exceed screening criteria. However, two surface water samples in the Jetty Sector exceeded the site-specific screening criteria for lead and arsenic.

Cheesequake Creek Inlet Exchange Study Results
The exchange study was conducted to estimate the flux of contaminants through the Cheesequake Creek Inlet. Contaminant flux for various flood tidal stages was estimated using Cheesequake Creek flow measurements and lead, arsenic, copper, antimony, and chromium data for surface water samples.

The concentrations of site-related metals in the inlet surface water were much lower than other areas of the site. In terms of bulk sediment and water, Cheesequake Creek was determined to be a net exporter of both sediments and water into Raritan Bay.

Summary of Margaret's Creek Sector
Sediment samples with co-located lead and arsenic that exceeded the preliminary site-specific screening criteria were limited to the shallow wetland areas. The co-location of lead and arsenic in sediment that exceeded the human health screening criteria was limited to one location. In deep sediments, co-located arsenic and lead concentrations above the preliminary site-specific screening criteria were limited to two widely-separated locations. Both of the high-resolution contaminant analysis cores showed that, in the top eight inches of core, both arsenic and lead exceeded the initial human health screening criteria.

No primary sources (e.g., slag or battery casings) were observed in the wetland sediment, which suggests that the source of sediment contamination is weathering of slag and battery casings and storm water runoff from upland sources. Contaminants are dispersed widely across the wetlands, and contamination is generally present only in the top 24 inches.

Two surface water samples collected from inside the Margaret's Creek channel exceeded surface water criteria for lead and arsenic. In the western, open-water portion of the wetlands, two surface water samples exceeded the site-specific levels for lead. No surface water samples in the eastern, open-water area exceeded any screening criteria. In Raritan Bay samples in the vicinity of Margaret's Creek, lead in surface water samples were detected above the site-specific screening levels.

In soils, co-located lead and arsenic that exceeded the preliminary site-specific screening criteria were identified in nine samples: one on the dunes, two adjacent to Area 1, and six in upland soils. Four shallow soil samples contained co-located arsenic and lead above the human health screening criteria. Two subsurface locations in the upland area exceeded the human health screening criteria for co-located lead and arsenic. The highest concentration of lead was located in the sample adjacent to Area 1.

The observed distribution of soil contamination is consistent with a model of non-contiguous "hot spots" rather than area-wide contamination. This finding is consistent with observations that sporadic dumping of waste on the ground surface occurred in the upland areas of Margaret's Creek.

Margaret's Creek Exchange Study Results
The Margaret's Creek exchange study evaluated the exchange of contaminants and sediment between the Margaret's Creek wetlands and Raritan Bay via Margaret's Creek (i.e., water and sediment flux). Water and sediment exchange in Margaret's Creek does not occur on a regular basis since the Margaret's Creek wetlands are at a higher elevation than mean high tide. Therefore, flux out of Margaret's Creek into Raritan Bay was measured. The average daily contaminant flux calculated from Margaret's Creek entering Raritan Bay was approximately 19.1 grams (g) of lead per day. The dissolved portion of the lead flux is estimated not to exceed 6.6 g per day. Margaret's Creek is a very small net exporter of contaminants and sediments into Raritan Bay.

Groundwater Sampling Results

Groundwater samples were collected from 21 monitoring wells in January 2011, and in April 2011from one well pair (MW-10S and MW-10D, to confirm lead results). MW-11S was installed at an upgradient location to monitor background conditions.

In background well MW-11S, aluminum, arsenic, iron, lead, manganese, and sodium exceeded their respective screening criteria, indicating that some of the concentrations above site-specific screening criteria in the other samples may not be related to site sources. Lead exceeded the site-specific screening criterion (5 micrograms per liter [µg /L]) in nine monitoring wells (excluding the background well). These wells are clustered around the three source areas: the western jetty, the seawall, and Margaret's Creek.

Several monitoring wells across the site contain naturally-occurring concentrations of cobalt, iron and/or arsenic that are impacting groundwater quality as a result of background or natural geochemical conditions. Groundwater in the area containing monitoring wells MW-07S-R1, MW08D-R1, MW-08S-R1, MW-09S-R1, MW-10D-R1, MW-10S-R1, and MW-12S-R is classified as Class III-B. This classification means that the groundwater is unsuitable for potable use, based in part on the presence of elevated levels of salinity and total dissolved solids that meet both federal and state guidelines for Class III-B aquifers. Groundwater is not currently used for drinking water at the site and future potable use of groundwater in the Class III-B portion of the aquifer is prohibited. Residents in the area are connected to the municipal water supply system for their drinking water.

SCOPE AND ROLE OF ACTION

EPA's preferred remedy to address contamination at the site is removal of slag, battery casings/associated wastes, soil/sediment above remediation cleanup levels, and monitoring. Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. The primary objective of the actions described in this Proposed Plan is to address potential current and future health and environmental impacts associated with site-related contamination.

ENFORCEMENT

Investigations are currently underway to identify potentially responsible parties (PRPs) for the site.

SUMMARY OF SITE RISKS

<u>Baseline Risk Assessment</u>

In 2011, EPA prepared a baseline human health risk assessment and a screening level ecological risk assessment for the Raritan Bay Slag site to estimate risks associated with current and future effects of contaminants on human health and the environment.

A baseline risk assessment is an analysis of the potential adverse human health and ecological effects caused by releases of hazardous substances from a site in the absence of any actions or controls to mitigate such releases, under current and future land, groundwater, surface water and sediment uses. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

<u>Human Health Risk Assessment (HHRA)</u>

For the HHRA, site characterization data were used to estimate potential risk at the site, focusing on exposure to soil, groundwater, surface water, sediment, and fish/shellfish. Exposure pathways and receptors evaluated for the site in the HHRA are listed below.

• Current Land Use Scenario: Recreational users in Area 1, Areas 3 through 6, and Area 9; anglers throughout the site except Areas 3 and 4 (biota samples were collected to represent lead in sediment from all Areas except Areas 3 and 4); pedestrians throughout the site except Areas 2, 8, and 11; trespassers in Areas 2, 8, and 11; outdoor workers in Areas 3 and 4; and construction/utility workers throughout the site.

• Future Land Use Scenario: Recreational users in Areas 1 through 6, and Area 9; anglers throughout the site except Areas 3 and 4 (biota samples were collected to represent lead in sediment from all Areas except Areas 3 and 4); pedestrians throughout the site except Areas 8 and 11; trespassers in Areas 8 and 11; outdoor workers in Areas 3 and 4; construction/utility workers throughout the site; and residents throughout the site.

No unacceptable cancer risks were identified for current or potential future exposure scenarios. The following exposure pathways resulted in unacceptable non-cancer hazards:

Lead

- Current/future ingestion of site soils in Area 2 (In Area 2, 42% of future recreational children exposed to the fine fraction of lead may have blood lead concentrations greater than 10 micrograms per deciliter (ug/dL). In all areas, 11% of the current/future developing fetuses of female construction/utility workers may also have blood lead concentrations greater than 10 ug/dL) from exposure to lead in soil.

Ecological Risk Assessments (ERA)

A Screening Level Ecological Risk Assessment (SLERA) and an ERA prepared by EPA/Environmental Response Team (ERT) (EPA/ERT 2010) evaluated the potential risks to ecological receptors from exposure to site chemicals. The SLERA evaluated Areas 8 and 9. EPA/ERT's risk assessment evaluated Area 1. A technical addendum to the SLERA was prepared to further evaluate potential risks to ecological receptors from exposure to site chemicals at Areas 1, 8, and 9 using less conservative assumptions. The results of the SLERA indicate that lead, arsenic, copper, iron, manganese, vanadium, and zinc in surface water, and lead in soil and sediment as the only risk drivers to aquatic receptors utilizing Areas 1 and 8 and terrestrial receptors utilizing Area 9 upland areas of the site.

REMEDIAL ACTION OBJECTIVES

The following remedial action objectives (RAOs) address the human health risks and environmental concerns at the Raritan Bay Slag Site. The RAOs are organized into the following categories: principal threat waste, slag and battery casings/associated wastes, soil, and sediment.

Principal Threat Waste:

Material that meets the definition of principal threat waste exists at the site and could pose potential unacceptable risks if appropriate remedial actions are not implemented.

- Remove or treat material that meets the definition of principal threat waste, to the extent practical, and
- Prevent current or potential future migration of material that meets the definition of principal threat waste from the site that would result in direct contact or inhalation exposure, to the extent practicable.

Principal threat wastes at the site include: (1) slag and battery casings/associated wastes, including particles of slag and battery casings/associated wastes identified in the soil and sediment media; (2) highly impacted soil in the Seawall Sector in portions of Areas 1 and 2, in the Jetty Sector in Area 8 and in the upland portion of the Margaret's Creek Sector; and (3) highly impacted sediment located in Area 8 in the Jetty Sector and Areas 1 and 2 in the Seawall Sector. The RAOs for each of these principal threat wastes are listed below.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and noncancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one in ten thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one in ten thousand to a one in a million excess cancer risk. For noncancer health effects, a "hazard index" (HI) is calculated. The key concept for a noncancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which noncancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at the site.

Slag and Battery Casings/Associated Wastes

The slag and battery casings/associated wastes contain high concentrations of lead which pose unacceptable human health and ecological risks, and act as a source of contamination for soil, sediment, groundwater, and surface water. The RAOs for the slag and battery casings/associated wastes are listed below.

• Reduce exposure resulting from incidental ingestion of slag and battery casings/associated wastes to levels that are protective of human health.

• Reduce exposure resulting from the ingestion of slag and battery casings/associated wastes to levels that are protective of ecological receptors.

• Reduce migration of contamination from the slag and battery casings/associated wastes to surface water, soil, and sediments to levels that are protective of human health and ecological receptors.

Soil

Soil in all Areas have been impacted by the slag and battery casings/associated wastes. Some of the areas contain slag particles with high concentrations of heavy metals. The contaminated soil poses risks to human health and ecological receptors and also serves as a secondary source for sediment, surface water, and groundwater contamination. The RAOs for the contaminated soil are listed below.

• Reduce exposure resulting from inhalation (from dust) and incidental ingestion of contaminated soil to levels protective of human health.

• Reduce exposure resulting from the ingestion of contaminated soil and ingestion of contaminants via food chain to levels protective of ecological receptors.

• Reduce migration of contamination from the soil to surface water, and sediments to levels that are protective of human health and ecological receptors in Area 9.

Sediment

Lead contamination in the sediment was identified in various areas in the Raritan Bay, in particular, areas near the seawall, western jetty, and Area 2. The contaminated sediment poses risks to the ecological receptors and also serves as a secondary source for the surface water contamination. The RAOs for the contaminated sediment are listed below.

• Reduce exposure resulting from the ingestion of contaminated sediments and ingestion of contaminants via food chain to levels protective of ecological receptors.

• Reduce the migration of contamination from the sediments to surface water, and soil to levels that are protective of human health and ecological receptors.

Surface Water

WHAT IS A "PRINCIPAL THREAT"?

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund Site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

Based on the RI results, surface water is contaminated with lead and other heavy metals from leaching of slag and battery casings/associated wastes, contaminated soil and sediment. Although surface water is not a source, the contamination poses risks to the ecological receptors. The RAO for surface water is listed below.

• Reduce metals concentrations to levels that are protective of ecological receptors by remediating source materials.

Remediation Cleanup Levels

To meet the RAOs defined above, EPA has identified remediation cleanup levels to aid in defining the extent of contaminated media requiring remedial action. In general, remediation cleanup levels establish media-specific concentrations of site contaminants that will pose no unacceptable risk to human health and the environment. Remediation cleanup levels have also been developed to establish criteria to define the source areas deemed principal threats for the site, areas for which EPA has concluded treatment should be considered as part of the remedy.

Remediation of Slag, Battery Casing/Associated Wastes
Slag, battery casing/associated wastes will be remediated based on visual observation (i.e., waste materials observed on-site during remedial action will be removed or remediated). Slag materials that are not readily visible will be remediated as soil/sediment.

Remediation of Surface Water
The approach to remediating the surface water contamination at the site is to remove the principal threat wastes that act as sources of contamination to the surface water. This will reduce the surface water contamination

over time to acceptable levels. Monitoring will be implemented to assess the effectiveness of the approach by comparing the monitoring results to a set of remedial goals presented in Table 1. Monitoring requirements for surface water will be developed during the design phase.

Remediation Cleanup Levels for Soil and Sediment

For soil and sediment media, a two-step process was used to develop the Preliminary Remediation Goal (PRG). In the first step, a PRG was derived based on parameters specific to each media. In the second step, the soil PRG and the sediment PRG was compared and a single PRG (the unified PRG) was proposed which aimed to collectively address the entire site as a whole regardless of environmental media (e.g., soil and sediment). A single unified PRG as shown in Table 1 was proposed due to the nature of the site (comingling/relationship between soil and sediment in the intertidal zone areas). There is significant potential for re-contaminating soil or sediment if the two media were remediated to different cleanup levels. Therefore, one unified remediation cleanup level is provided for soil/sediment.

As previous noted, once the decision to take action was made and the discussion on PRGs was started, it was determined that since the unified PRG approach was most appropriate for this site, using a background concentration for wetland sediments from an area not tidally connected to the site was determined not to be appropriate. Therefore, only the soil and sediment data collected from Area 10 was used in the background evaluation for the purposes of PRG selection. Sediments collected from Whaler's Creek were only used for ecological risk purposes.

For lead, a unified remediation cleanup level of 400 milligrams per kilogram (mg/kg) was selected. This value represents the human health risk-based number which is also protective of aquatic ecological receptors based on site-specific data.

SUMMARY OF REMEDIAL ALTERNATIVES

Common Elements

Many of these alternatives include common components. Because most of the remedial alternatives will result in some contaminants remaining on the site above levels that would allow for unrestricted use (except Alternative 2), a review of these remedies will be conducted every five years, at minimum.

While exposure to surface water or groundwater did not pose any unacceptable human health risks, long-term monitoring is proposed to assess impacts from remedial activities and to ensure that surface water concentrations decrease below acceptable levels once source materials are removed. Groundwater will be monitored solely to assess impacts from remedial activities. Monitoring requirements for groundwater and surface water will be developed during the design phase.

The disposal requirements for all alternatives would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail Toxicity Characteristic Leaching Procedure (TCLP) criteria would require treatment to meet the Land Disposal Restriction (LDR) Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. Certified clean material/fill/sands would be placed as appropriate at the excavated areas.

Dewatering would be applicable to all alternatives except the No Action alternative that involve removal of sediment and excavation of beach sand below the groundwater.

Long-term monitoring (LTM) and maintenance (except Alternative 2) would include periodic sampling and analysis of surface water, groundwater, soil, sediment, toxicity studies and/or caged bivalve studies at site locations. For alternatives that include installation of engineered containment structure(s) or installation of a cap, additional monitoring of sediment and maintenance of containment cells and caps would be performed to assess effectiveness or track progress. Details of LTM would be determined during the design phase.

In addition, institutional controls (ICs) such as a deed notice or restrictive covenant would be required for portions of the site as one component of maintaining the long-term protectiveness of all alternatives with the exception of Alternative 2. The FS addresses the objectives of ICs in more detail which are not limited to: (1) prevent exposure to contaminant concentrations, (2) control future development that could result in increased risk of exposure, and (3) restrict installation of drinking water wells within the contaminated area. Once a remedy is selected, a detailed ICs implementation strategy can be identified and refined in the design. This will entail reviewing current existing bay-wide advisories and evaluating against the selected remediation cleanup levels with input from stakeholders. Entities responsible to carry out the ICs and ensure that they are functioning as intended will be identified in the design.

All the alternatives, with the exception of the no further action alternative, include excavation/dredging of slag, battery casings/associated wastes, some volume of offsite disposal of contaminated soil and sediment and monitoring (see Figures 3 through 6).
A total of five alternatives were carried through the

screening process presented in the Comprehensive Site-wide FS. Please refer to Section 3, Development of Remedial Action Alternatives, and Section 4, Detailed Analysis of Alternatives, of the FS for a more detailed discussion of all the remedial alternatives.

Alternative 1 - No Action

Capital Cost:	$0
Total O&M Costs:	$0
Total Present Worth:	$0
Implementation Timeframe:	Not Applicable

The NCP requires that a "No Action" alternative be developed as a baseline for comparing other remedial alternatives. Under this alternative, no action would be implemented to restore the contaminated soil or sediment or to remove the source materials. Contamination would continue to migrate from the slag to other media such as sediment and soil, and subsequently to surface water and groundwater. Alternative 1 does not include institutional controls.

Alternative 2 – Excavation/Dredging, Off-site Disposal, and Monitoring

Capital Cost:	*$78,200,000*
Total O&M Costs:	*$500,000*
Total Present Worth:	*$78,700,000*
Implementation Timeframe	*2 Years*

Under this alternative, slag, battery casing/associated wastes, contaminated soils and sediment above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the Land Disposal Restriction Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. Contaminated wastes that pass TCLP can be disposed in a Subtitle D landfill without treatment. Certified clean material/fill/sands would be placed as appropriate at the excavated areas. Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. Figure 3 presents the conceptual design for Alternative 2.

Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Off-site Disposal of Soil and Sediment, Institutional Controls and Long-Term Monitoring

Capital Cost:	*$69,000,000*
Total O&M Costs:	*$4,000,000*
Total Present Worth:	*$73,000,000*
Implementation Timeframe	*2 Years*

Under this alternative, the slag and battery casing/associated wastes would be placed in on-site containment cells consisting of bottom liners, collection systems, lined containment walls or berms, and a low permeability cover. These cells would be constructed within the site in the upland area of Margaret's Creek and in the asphalt area near the western jetty. There would be a wetland transition zone between the containment cell and the wetland at the Margaret's Creek upland area. Treatment of slag to meet land disposal requirements prior to placement in the containment cell would not be required, as this operation is consolidation of waste materials within an Area of Contamination, which exempts waste consolidation from meeting LDR requirements. All contaminated soil and sediment above the remediation cleanup levels would be disposed of at appropriate off-site facilities as discussed under Alternative 2. Similar to Alternative 2, Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. Figure 4 presents the conceptual design for Alternative 3.

Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring

Capital Cost:	*$44,200,000*
Total O&M Costs:	*$5,600,000*
Total Present Worth:	*$49,800,000*
Implementation Timeframe	*2 Years*

Under this alternative, a selected remediation target area in Area 8 would be capped. This alternative would also include on-site containment of slag, battery casings/associated wastes, and contaminated soil and sediment above the remediation cleanup levels excavated or dredged from other site areas. The contaminated materials from the Jetty Sector would be placed in a containment cell constructed within the Jetty Sector and the contaminated materials from the Seawall and Margaret's Creek Sectors would be placed in a containment cell constructed within the Margaret's Creek Sector upland area. However, the on-site containment cell in the Jetty Sector would not have the capacity to contain all the contaminated soil and sediment from the Jetty Sector. Therefore, the excavated soil and dredged sediment that could not be accommodated in the containment cells would be disposed of at appropriate off-site facilities similar to Alternative 2. For the containment cell in the Margaret's Creek Sector, there would be a wetland transition zone between the containment cell and the nearby wetland areas. Similar to Alternative 2, Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. Figure 5 presents the conceptual design for Alternative 4.

Alternative 5 - Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring

Capital Cost:	*$47,900,000*
Total O&M Costs:	*$4,500,000*
Total Present Worth:	*$52,400,000*
Implementation Timeframe	*2 Years*

This alternative would be similar to Alternative 4 except capping of Area 8 would not be implemented. Instead, the contaminated sediment from Area 8 would be dredged and disposed of at appropriate off-site facilities. Figure 6 presents the conceptual design for Alternative 5.

Tables 2 and 3 summarize the volumes of slag, battery casings/associated wastes, contaminated soil and sediment addressed by alternatives.

EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy, (see table below, Evaluation Criteria for Superfund Remedial Alternatives). This section of the Proposed Plan describes the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A Detailed Analysis of Alternatives can be found in the FS Report.

1. Overall Protection of Human Health & the Environment

Alternative 1 would not protect human health and the environment. Alternatives 2 through 5 would provide protection to human health and the environment. However, during dredging operations under Alternatives 2 through 5, risks to ecological receptors would temporarily increase due to the disruption caused to the aquatic habitat from the dredging operation. For Alternative 2, human health risk would be eliminated or greatly reduced through removal of contaminated materials. For Alternatives 3 through 5, human health risk would be eliminated or greatly reduced through removal and containment of contaminated materials; however, long-term maintenance of the containment cells would be required for these alternatives.

The contaminated land would be restored to beneficial use with Alternatives 2 through 5.

Alternative 1 would not meet the RAOs. Alternatives 2 would meet the RAOs. Alternatives 3 through 5 would meet the RAOs provided that on-site containment is properly maintained.

2. Compliance with ARARs

Alternative 1 would not comply with chemical-specific applicable or relevant and appropriate requirements (ARARs) because no action would be taken. Alternative 2 would comply with chemical-specific ARARs through removal and off-site disposal. Alternatives 3 through 5 would comply with chemical-specific ARARs through various remedial activities. Action-specific and location-specific ARARs are not applicable to Alternative 1 since no action would be taken. Alternatives 2 through 5 would comply with action-specific ARARs by implementing health and safety measures during the remedial action, and by meeting regulatory requirements necessary for remedy implementation. Alternatives 2 through 5 would also comply with location-specific ARARs by meeting wetland, coastal zone, and siting requirements. Coastal restoration would be required for Alternatives 2 through 5.

3. Long-Term Effectiveness and Permanence

Alternative 1 would not be considered a permanent remedy and does not achieve long-term effectiveness since no action would be taken. Alternative 2 would remove the contaminated materials from the current unprotected locations and would achieve long-term effectiveness and permanence. Alternatives 3 through 5 would achieve long-term effectiveness through a combination of removal, off-site disposal, on-site containment and capping and would be permanent if long-term site controls are maintained.

4. Reduction in Mobility, Toxicity or Volume through Treatment

Alternative 1 would not reduce Toxicity/Mobility/Volume (T/M/V) through treatment since no treatment would be implemented. Alternatives 3 through 5 would not reduce T/V through treatment on-site; however, off-site disposal, on-site containment, and capping under Alternatives 3 through 5 would reduce the mobility of the contaminants. The use of reactive capping technologies for Alternative 4 would further reduce contaminant mobility. The toxicity of site-related metals in contaminated materials would be reduced if treatment is conducted at the off-site disposal facility.

5. Short-Term Effectiveness

Alternative 1 would not have any short-term impact since no action would be taken. Alternatives 2 through 5 would have impacts to the community during pre-design investigations, source removal, soil excavation, sediment dredging, material handling, on-site containment, capping, and transportation and disposal operations. Alternative 2 would have larger impact on the community since it would involve major construction operations on-site, and heavy traffic on local roads during the transportation and disposal of contaminated materials off-site. Alternatives 3 through 5 would not cause as much traffic on local roads as the volume of materials disposed of off-site is lower in these alternatives. However, the on-site construction activities under Alternatives 3 through 5 would be greater due to the construction of containment cells. Due to re-suspension of sediment during dredging operations, significant adverse impact to the aquatic habitat would be expected to occur temporarily in Alternatives 2 through 5. To the extent practicable, areas designated for dredging would be dewatered prior to operations to avoid re-suspension.

6. Implementability

Alternative 1 would be the easiest to implement since it involves no action. Alternatives 2 through 5 would be technically implementable and would use conventional construction equipment, although there would be several technical challenges related to dredging and dewatering the sediment, segregating the slag, accessing work areas, siting of on-site containment cells, capping under water, and transportation logistics. Alternatives 2 through 5 would also encounter some technical challenges with regards to coastal restoration. Additionally, Alternatives 3 through 5 also could face potential issues due to settlement of the ground following placement of contaminated material in the containment cells. Alternative 2 would be the easiest to implement among the action alternatives, as it would not involve the construction and long-term maintenance of the containment cells. Alternatives 3, 4 and 5 would be more difficult to implement, as they would involve construction and long-term maintenance of the containment cells. Alternative 4 would additionally involve maintenance and monitoring of the in-situ cap.

7. Costs

Alternative 1 would not involve any costs. Alternative 2 would have the highest capital cost due to transportation and

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that are legally applicable, or relevant and appropriate to the site, or whether a waiver is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

disposal of the contaminated materials. Alternative 4 would have the lowest cost because of the use of capping. Table 4-3 in the FS summarizes the capital, operations and maintenance, and present worth costs for each alternative.

8. State/Support Agency Acceptance

The State of New Jersey concurs with EPA's preferred alternative as presented in this Proposed Plan.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Record of Decision, the document that formalizes the selection of the remedy for the site.

PREFERRED ALTERNATIVE

EPA has identified Alternative 2 as the preferred alternative. This alternative provides for the removal of all Principal Threat Waste (PTW), soil and sediment above the remediation cleanup level (see Table 1). Under this alternative, slag, battery casing/associated wastes (approximately 11,100 cubic yards), and contaminated soils and sediment (approximately 81,000 cubic yards) above the cleanup level would be excavated and/or dredged and disposed of at appropriate off-site facilities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the LDR Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas.

The Preferred Alternative at an estimated cost of $78.7 Million is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. The Preferred Alternative will not result in contaminants remaining on the site above levels that would require restricted use. In addition, a review of the remedy will not be required every five years and the Preferred Alternative will not require long-term monitoring. The removal of all PTW is preferred to those alternatives with on-site containment located in a recreational area and residential community. As the leaching tests conducted as part of the RI indicate, the slag and battery casings exhibit the potential for leaching. EPA believes that the Preferred Alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The preferred alternative can change in response to public comment or new information.

It should also be noted that the Preferred Alternative was reviewed by the National Remedy Review Board. The Board, which includes program experts across EPA, evaluates proposed high-cost remedies for cost effectiveness and national consistency. The Board comments and Regional response are included in the administrative record for the site.

COMMUNITY PARTICIPATION

EPA encourages the public to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted there.

The dates for the public comment period, the date, location and time of the public meeting, and the locations of the Administrative Record files, are provided on the front page of this Proposed Plan. Written comments on the Proposed Plan should be addressed to the Remedial Project Manager or Community Involvement Coordinator listed below.

EPA Region 2 has designated a Regional Public Liaison as a point-of-contact for the community concerns and questions about the federal Superfund program in New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands. To support this effort, the Agency has established a 24-hour, toll-free number that the public can call to request information, express their concerns, or register complaints about Superfund. This information is provided below.

For further information on the Raritan Bay Slag Superfund Site, please contact:

Tanya Mitchell	Pat Seppi
Remedial Project Manager	Community Involvement Coordinator
(212) 637-4362	(212) 637-3679
mitchell.tanya@epa.gov	seppi.pat@epa.gov

Written comments on this Proposed Plan should be mailed to Ms. Mitchell at the address below or sent via email.

U.S. EPA
290 Broadway, 19th Floor
New York, New York 10007-1866

The public liaison for EPA's Region 2 is:

George H. Zachos
Regional Public Liaison
Toll-free (888) 283-7626
(732) 321-6621

U.S. EPA Region 2
2890 Woodbridge Avenue, MS-211
Edison, New Jersey 08837-3679

Table 1
Remediation Cleanup Levels
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

COCs	Slag/Battery Casing/ Associated Wastes	Contaminated Soil and Sediment (mg/kg)	Surface Water (µg/L)	Basis
Lead	Removal of source materials by visual observation	400	24	Human health risk-based value
Arsenic	NA	NA	36	ARAR based value
Copper	NA	NA	3.1	ARAR based value
Iron	NA	NA	1,000	ARAR based value
Manganese	NA	NA	120	ARAR based value
Vanadium	NA	NA	20	ARAR based value
Zinc	NA	NA	81	ARAR based value

Notes:
COCs - Contaminants of Concern
NA - Not Applicable
ARAR - Applicable or Relevant and Appropriate Requirement
mg/kg - milligrams per kilogram
µg/L - micrograms per liter

Table 2
Summary of Proposed Alternatives
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

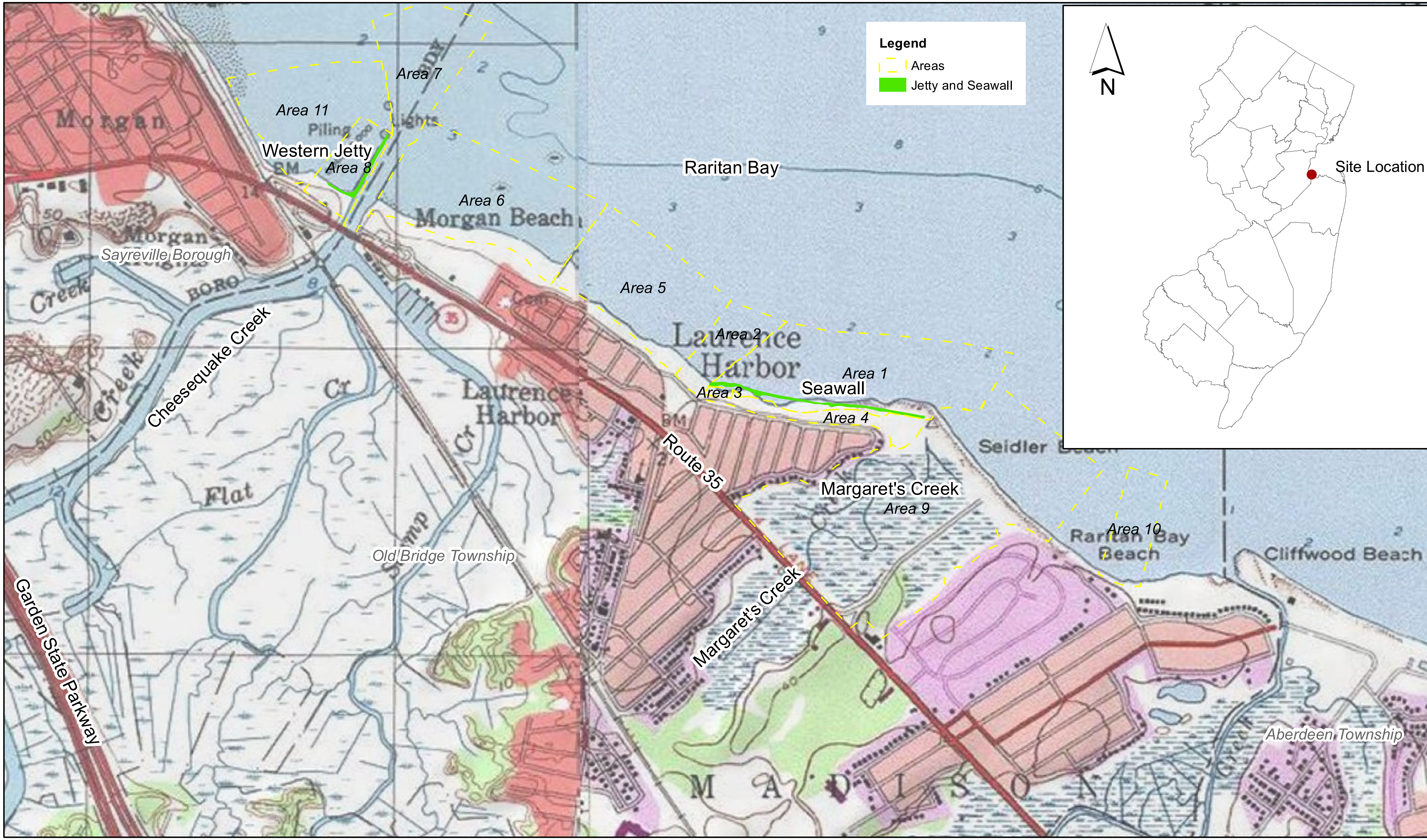
List of Alternatives	Description	Source Material Volume		Soil/Sediment Volume		Containment Cell Volume	Capping Volume (Area 8)
		On-Site	Off -Site	On-Site	Off-Site	On-Site	On-Site
Alternative 1	No Action						
Alternative 2	Excavation/Dredging, Offsite Disposal, and Monitoring		11,100		81,000		
Alternative 3	Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring	11,100*			81,000	11,100	
Alternative 4	Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring	11,100*		61,400*	10,400	72,500	9,200
Alternative 5	Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring	11,100*		61,400*	19,600	72,500	

Note: 1) All volumes are reported in cubic yards 2) * Volume included under onsite containment cells

Table 3
Summary of Volumes Addressed by Remedial Components of Alternatives
Feasibility Study
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, NJ

	Alternative 2				Alternative 3				Alternative 4				Alternative 5			
	Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment	
	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors
Volume addressed by Off-site Disposal (CY) *	5,000	6,100	25,300	55,700	-	-	25,300	55,700	-	-	10,400	-	-	-	19,600	-
Volume addressed by On-site Containment (CY) *	-	-	-	-	5,000	6,100	-	-	5,000	6,100	5,700	55,700	5,000	6,100	5,700	55,700
Volume addressed by Capping (CY) *	-	-	-	-	-	-	-	-	-	-	9,200	-	-	-	-	-
Total Volume (CY) *	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700

Notes:
CY - Cubic Yards
MC - Margaret's Creek
Alternative 1 - No Action
Alternative 2 – Excavation/Dredging, Offsite Disposal, and Monitoring
Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring
Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring
Alternative 5 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring
* - All volumes are rounded to the nearest hundred CY



Source: USGS Topographic Quadrangle

0 500 1,000 2,000 3,000 Feet

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Figure 1
Site Map
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, New Jersey

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Seawall Sector	Area 1: Laurence Harbor Seawall	The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
	Area 2: Laurence Harbor Beach	The beach area at the foot of Laurence Parkway between the western end of the seawall and the first jetty.
	Area 3: Laurence Harbor Playground	The park playground adjacent to the western end of the seawall.
	Area 4: Old Bridge Waterfront Park	The park area along the seawall (not including the playground) from the fence to the roadway.
	Area 5: Laurence Harbor Beach	The beach area between the first and third jetty.
	Area 6: Laurence Harbor Beach	The beach area between the third jetty and Cheesequake Creek Inlet eastern jetty.
Jetty Sector	Area 7: Cheesequake Creek Inlet	The inlet between the eastern and western jetties from the Route 35 Bridge into Raritan Bay to the extent of sediment deposition.
	Area 8: Cheesequake Creek Inlet Western Jetty	The jetty and adjacent subtidal area west of the inlet in Sayreville.
	Area 11: Western Extent	The extent of the site west of Area 8.
Margaret's Creek Sector	Area 9: Margaret's Creek	The wetlands and upland areas associated with the Creek (between the beach and Route 35), including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
Background Area	Area 10: Background Area	The historical background sampling location.

0 1,000 2,000 4,000 Feet

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Figure 2
Investigation Areas
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, New Jersey

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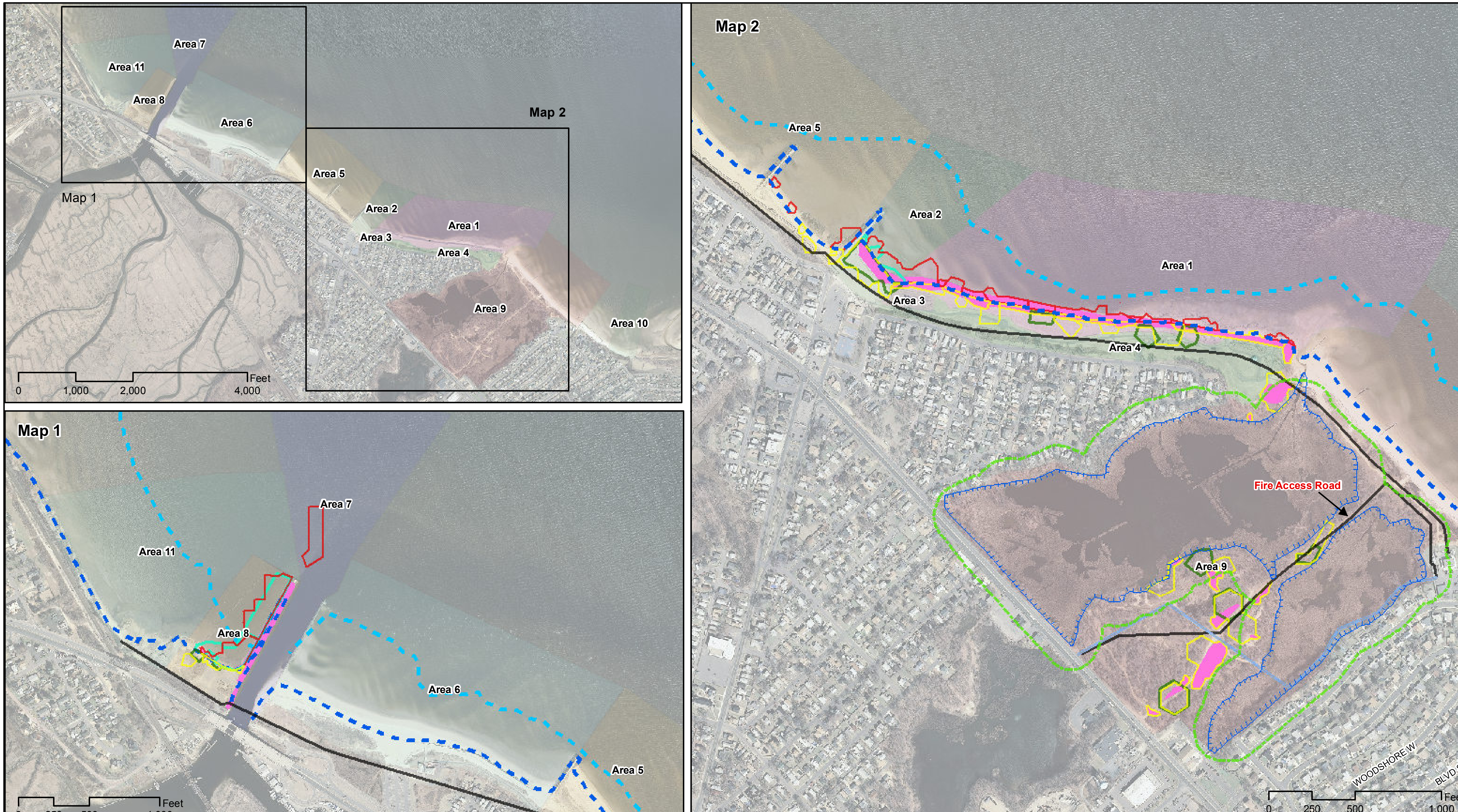

Legend

Surface Remediation Target Area
- Surface Soil
- Surface Sediment

Subsurface Remediation Target Area
- Subsurface Soil
- Subsurface Sediment
- Soil/Sediment Demarcation Line
- Existing Sewerline
- Abandoned Sewerline
- Mean high tide line
- Spring low tide line
- Wetlands and wetland transition zone (estimated)
- Slag and Battery Casings/Associated Wastes

1. Alternative 2 consists of removal and off-site disposal of contaminated materials, and monitoring of surface water.
2. The slag and battery casings/associated wastes will be removed from the areas shown and disposed of to Subtitle C landfill.
3. The contaminated soil will be excavated and disposed of to Subtitle D or Subtitle C landfill based on the TCLP test results.
4. The contaminated sediment will be dredged, dewatered and disposed of to a Subtitle D or Subtitle C landfill based on the TCLP test results.
5. The existing sewerline is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

Figure 3
Conceptual Design for Alternative 2 - Off-Site Disposal
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

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R2-0015297

Legend

Remedy = Removal

- Surface Soil
- Surface Sediment
- Subsurface Soil
- Subsurface Sediment
- Soil/Sediment Demarcation Line
- Wetlands and wetland transition zone (estimated)
- Existing Sewerline
- Abandoned Sewerline
- Mean high tide line
- Spring low tide line
- Slag and Battery Casings/Associated Wastes

1. Alternative 3 consists of the following components:
   i. On-site containment of source materials in containment structures or "cells"
   ii. Removal and off-site disposal of remaining contaminated soil and sediment
   iii. Long-term monitoring of the site, including the monitoring and maintenance of the containment cells and institutional control measures.
2. The slag and battery casings/associated wastes from the Jetty Sector will be removed and contained within Cell A near the western jetty and the slag and battery casings from the Seawall and Margaret's Creek Sectors will be placed within Cell B in the upland areas of the Margaret's Creek Sector at the locations shown in the figure.
3. The removal and off-site disposal of remaining contaminated soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.
4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.
5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.
6. IC measures would include deed restrictions and biennial certification regarding the maintenance of the cells.
7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

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Figure 4
Conceptual Design for Alternative 3
On-Site Containment of Source Materials
and Off-site Disposal of Soil and Sediment
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

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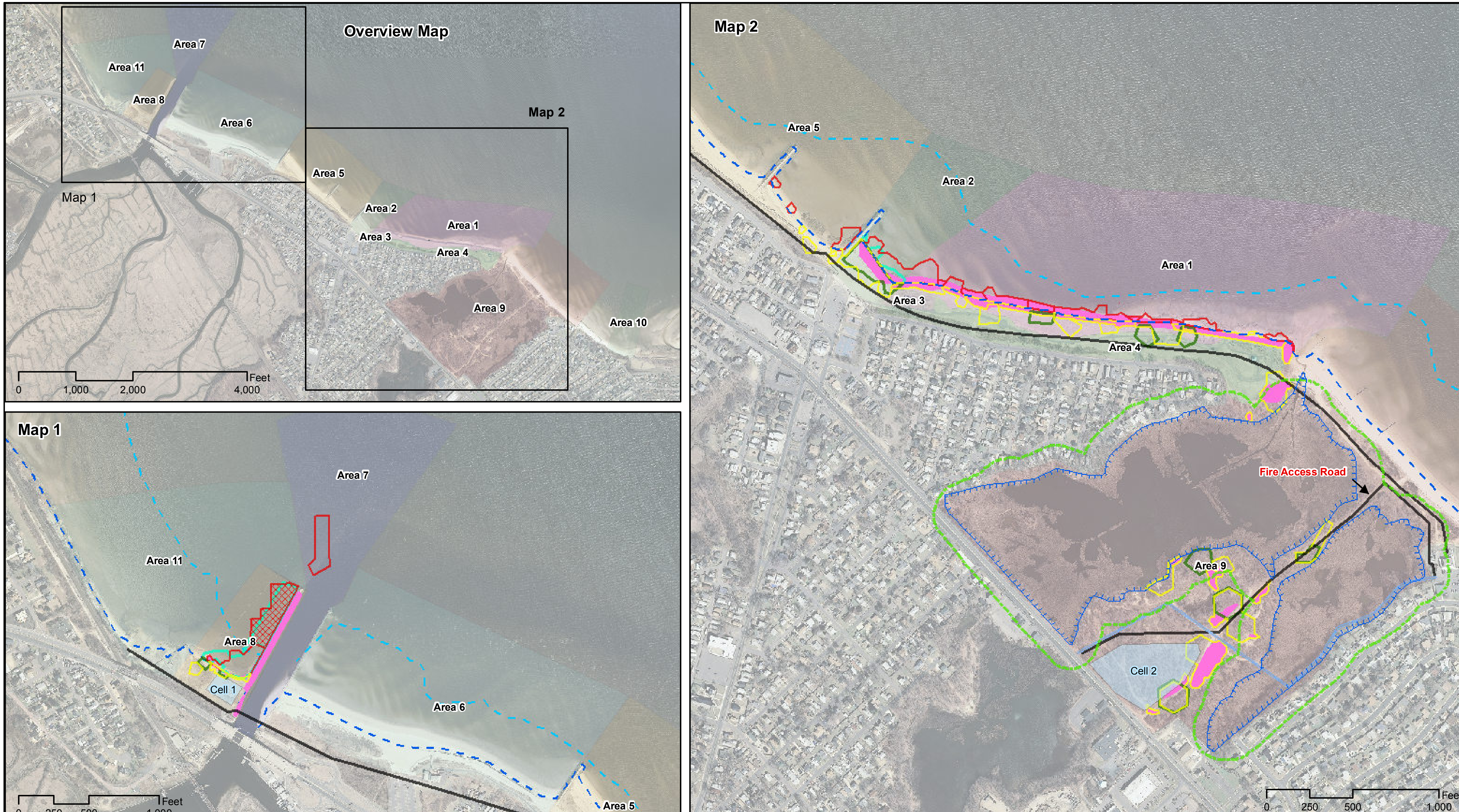

Legend

- Sediment Cap
- Containment Cell

Remedy = Removal

- Surface Soil
- Surface Sediment
- Subsurface Soil
- Subsurface Sediment
- Wetlands and wetland transition zone (estimated)
- Existing Sewerline
- Abandoned Sewerline
- Mean high tide line
- Spring low tide line
- Slag and Battery Casings/Associated Wastes
- Soil/Sediment Demarcation Line

1. Alternative 4 consists of the following components:
   i. Capping of a select area of contaminated sediments in Area 8
   ii. On-site containment of source materials and soil and sediment in containment structures or "cells"
   iii. Removal and off-site disposal of remaining contaminated soil and sediment
   iv. Long-term monitoring of the site, including the monitoring and maintenance of the containment cells, cap, and institutional control measures.
2. The slag, battery casings/associated wastes, soil and sediment from the jetty sector will be removed and contained within Cell 1 near the western jetty and the slag, battery casings, soil and sediment from the seawall and Margaret's creek Sectors will be placed within Cell 2 in the Margaret's Creek upland area shown in the figure.
3. The removal and off-site disposal of remaining contaminated soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.
4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.
5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.
6. IC measures would include deed restrictions at the cell areas and biennial certification regarding the maintenance of the cells .
7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

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Figure 5
Conceptual Design for Alternative 4
Capping, On-Site Containment, and Off-site Disposal
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

EPA

Legend

Containment Cell

Remedy = Removal

- Surface Soil
- Surface Sediment
- Subsurface Soil
- Subsurface Sediment

Wetlands and wetland transition zone (estimated)

Existing Sewerline

Abandoned Sewerline

Mean high tide line

Spring low tide line

Slag and Battery Casings/Associated Wastes

Soil/Sediment Demarcation Line

1. Alternative 5 consists of the following components:
   ii. On-site containment of source materials and contaminated soil and sediment in containment structures or “cells”
   ii. Removal and off-site disposal of remaining contaminated soil and sediment
   iii. Long-term monitoring of the site, including the monitoring and maintenance of the containment cells and institutional control measures.
2. The slag, battery casings/associated wastes, soil, and sediment from the jetty sector will be removed and contained within Cell 1 near the western jetty and the slag, battery casings, soil, and sediment from the seawall and Margaret’s creek Sectors will be placed within Cell 2 in the Margaret’s Creek upland area shown in the figure.
3. The removal and off-site disposal of remaining soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.
4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.
5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.
6. IC measures would include deed restrictions at the cell areas and biennial certification regarding the maintenance of the cells.
7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

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Figure 6
Conceptual Design for Alternative 5
On-Site Containment, Off-site Disposal
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

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